What is claimed is:

1. A method for manufacturing a semiconductor device, comprising:

(1) a step of forming a first film on a major surface of a substrate;

(2) a step of patterning said first film in a predetermined pattern;

(3) a step of placing said substrate having said patterned first film in a process chamber; and

(4) a step of placing, on said major surface of said substrate, a pad structure having an opposing major surface to said major surface of said substrate and having a gas ejection section provided on said opposing major surface, and ejecting a predetermined gas from said gas ejection section in a depressurized state in said process chamber while keeping a predetermined distance between said major surface of said substrate and said opposing major surface.

2. The method according to claim 1, wherein in said step (4), said pad structure is moved in relative to said substrate.

3. The method according to claim 1 or 2, wherein said substrate is a semiconductor wafer.

4. The method according to claim 1, wherein a plurality of gas ejection sections provided on said opposing major surface of said pad structure are placed apart from one another, and said predetermined gas is ejected toward said major surface of said substrate

from said plurality of gas ejection sections substrate in said step (4).

5. The method according to claim 4, wherein said plurality of gas ejection sections include a single gas ejection section located in a center of said pad structure and a plurality of gas ejection sections arranged at a peripheral portion of said pad structure.

6. The method according to claim 1, wherein said predetermined gas consists of one of Ar, nitrogen, He and Ne.

7. The method according to claim 3, wherein a diameter of said pad structure is smaller than a diameter of said semiconductor wafer.

8. A method for manufacturing a semiconductor device, comprising:

(1) a step of forming an insulating film on a major surface of a semiconductor substrate;

(2) a step of forming a hole in said insulating film by dry etching;

(3) a step of placing said semiconductor substrate having said hole-formed insulating film in a process chamber; and

(4) a step of keeping inside said process chamber in a depressurized state, placing a pad structure having a gas ejection section provided on a major surface thereof in such a way that said major surface of said pad structure faces said insulating film formed on said major surface of said semiconductor

substrate, and ejecting a predetermined gas from said gas ejection section, thereby cleaning a surface of said insulating film having said hole.

9. The method according to claim 8, wherein following said step (4), a conductor film is formed on said insulating film in such a way as to bury said hole.

10. The method according to claim 8, wherein said insulating film comprises an organic insulating film.

11. The method according to claim 8, wherein in said step (4), said major surface of said pad structure is moved in relative to said major surface of said substrate.

12. The method according to claim 8, wherein in said step (4), said major surface of said pad structure is moved in relative to said semiconductor substrate on which said insulating film is formed.

13. A method for manufacturing a semiconductor device, comprising:

(1) a step of forming a semiconductor substrate having one major surface having undergone a predetermined process in a process chamber having pumping means; and

(2) a step of supplying a predetermined gas in said process chamber to form a plasma environment and relaxing a bonding force of a foreign matter stuck on said one major surface.

14. The method according to claim 13, wherein

relaxation of said bonding force of said foreign matter is accomplished by an electric field applied between said plasma environment and said one major surface of said semiconductor substrate.

15. The method according to claim 13, wherein relaxation of said bonding force of said foreign matter is accomplished by adsorbing an acidic active species to said foreign matter.

16. The method according to claim 15, wherein said predetermined gas is an oxygen gas.

17. The method according to claim 15, wherein one of CF_4, C_2F_6, C_3F_8, Cl_2, F_2, HF, ammonia and hydrogen is used as said predetermined gas.

18. The method according to claim 15, wherein in said step (2), said semiconductor substrate is heated to 300 °C or lower.

19. A method for manufacturing a semiconductor device, comprising:

a step of inserting a semiconductor substrate in a process chamber;

a step of supplying a first gas into said process chamber to thereby form a plasma environment; and

a step of ejecting a second gas toward said semiconductor substrate in said process chamber where said plasma environment is formed.

20. The method according to claim 19, wherein one of CF_4, C_2F_6, C_3F_8, Cl_2, F_2, HF, ammonia and hydrogen

and said second gas is one of Ar, nitrogen, He and Ne is used as said predetermined gas.

21. A method for manufacturing a semiconductor device, comprising:

a step of forming a film having a predetermined pattern on a major surface of a semiconductor substrate;

a step of inserting said semiconductor substrate in a process chamber;

a step of supplying a gas into said process chamber to thereby form a plasma environment; and

a step of placing a pad structure having a gas ejection section provided on an opposing major surface in such a way as to face said film having said predetermined pattern of said semiconductor substrate, ejecting a predetermined gas from said gas ejection section while keeping a predetermined distance between a major surface of said semiconductor substrate and said opposing major surface, in said process chamber where said plasma environment is formed.

22. The method according to claim 21, wherein one of Ar, nitrogen, He and Ne is used as said predetermined gas.

23. The method according to claim 21, wherein said film having said predetermined pattern is comprised of an insulating film and said predetermined pattern is formed by plasma etching.

24. The method according to claim 21, wherein

said film having said predetermined pattern is comprised of a conductor film and said predetermined pattern is formed as a plurality of wiring layers by plasma etching.

25. The method according to claim 24, wherein said conductor film is formed of polycrystalline silicon.

26. A method for manufacturing a semiconductor device by using a semiconductor manufacturing apparatus having a first vacuum chamber, a second vacuum chamber and a vacuum transfer chamber having a transfer arm for transferring a semiconductor wafer to said first and second process chambers, comprising:

a step of transferring said semiconductor wafer into said first vacuum chamber by said transfer arm and subjecting said semiconductor wafer to a plasma process in said first vacuum chamber;

a step of transferring said semiconductor wafer undergone said plasma process into said second vacuum chamber by said transfer arm and ejecting a predetermined gas toward a major surface of said semiconductor wafer in said second vacuum chamber to clean said major surface of said semiconductor wafer.

27. The method according to claim 26, wherein a pad structure having a gas ejection section provided on a major surface thereof is placed in said second vacuum chamber, said major surface of said semiconductor wafer and said major surface of said pad

structure are arranged to face each other while keeping a predetermined distance therebetween, and said predetermined gas is ejected from said gas ejection section to clean said major surface of said semiconductor wafer.

28. The method according to claim 26, wherein said major surface of said semiconductor wafer has an insulating film and said plasma process of said semiconductor wafer in said first vacuum chamber is plasma etching to form a hole in said insulating film.

29. The method according to claim 26, wherein said semiconductor wafer is processed wafer by wafer in said first and second vacuum chambers.

30. A method for manufacturing a semiconductor device, comprising:

(1) a step of performing a first process on a major surface of a semiconductor substrate in a depressurized environment;

(2) a step of arranging a cleaning pad having a gas ejection section provided on a major surface thereof close to said major surface of said semiconductor substrate, and ejecting a predetermined gas from said gas ejection section while keeping a predetermined distance between said major surface of said cleaning pad and said major surface of said semiconductor substrate to clean said major surface of said semiconductor substrate in a depressurized environment; and

(3) a step of performing a second process on said major surface of said semiconductor substrate in a depressurized environment.

31. The method according to claim 30, wherein said first process is a step of depositing a conductor film on said major surface of said semiconductor substrate, and said second process is a step of etching said conductor film.

32. The method according to claim 31, wherein said conductor film is formed of polycrystalline silicon.

33. A method for manufacturing a semiconductor device, comprising:

a step of performing a first process on a semiconductor substrate in a depressurized environment; and

a step of performing a second process on said semiconductor substrate in a depressurized environment,

a predetermined gas being led to flow along said major surface of said semiconductor substrate in a depressurized environment.

34. The method according to claim 33, wherein said first process is dry etching of an insulating film with a photoresist film used as a mask, and said second process is ashing of said photoresist film.

35. A method for manufacturing a semiconductor device, comprising:

(1) a step of loading a semiconductor wafer

into a process chamber;

(2) a step of performing a plasma process on a major surface of said semiconductor wafer and performing a cleaning process on said major surface with a gas stream; and

(3) a step of unloading said semiconductor wafer from said process chamber.

36. A method for manufacturing a semiconductor device for forming a mask on a major surface of a semiconductor wafer by a photolithography technique and patterning said major surface of said semiconductor wafer into a predetermined pattern using said mask, wherein said patterning of said major surface of said semiconductor wafer into said predetermined pattern, removal of said mask and cleaning of said major surface of said semiconductor wafer are performed in process chambers in a depressurized environment.

37. The method according to claim 36, wherein said patterning of said major surface of said semiconductor wafer is performed in a process chamber for dry etching, said removal of said mask is performed in an ashing chamber, and said cleaning of said major surface of said semiconductor wafer is performed in a cleaning chamber.

38. The method according to claim 37, wherein said chambers are connected to a multichamber transfer chamber for keeping a depressurized environment, and transfer of said semiconductor wafer to each of said

chambers is carried out by a wafer transfer arm provided in said multichamber transfer chamber.

39. A method for manufacturing a semiconductor device, comprising:

(1) a step of forming an insulating film on a major surface of a semiconductor substrate;

(2) a step of forming a photoresist mask having a predetermined pattern on said insulating film;

(3) a step of exposing said semiconductor substrate having said mask formed thereon to a depressurized environment and generating a plasma in said depressurized environment to etch a part of said insulating film where said mask is not formed;

(4) a step of, after said etching, exposing said semiconductor substrate to a depressurized environment, generating a plasma in said depressurized environment, placing a pad structure having a major surface for ejecting a gas in such a way as to face said major surface of said semiconductor substrate, and ejecting a predetermined gas from said major surface of said pad structure to clean said major surface of said semiconductor substrate while keeping a predetermined distance between said major surface of said semiconductor substrate and said major surface of said pad structure;

(5) a step of exposing said cleaned semiconductor substrate to a depressurized environment and generating a plasma in said depressurized

environment to remove said mask; and

(6) a step of, after removal of said mask, exposing said semiconductor substrate to a depressurized environment, generating a plasma in said depressurized environment, placing said pad structure having said major surface for gas ejection in such a way as to face said major surface of said semiconductor substrate, and ejecting a predetermined gas from said major surface of said pad structure to clean said major surface of said semiconductor substrate while keeping a predetermined distance between said major surface of said semiconductor substrate and said major surface of said pad structure.